Advances in Nuclear Nonproliferation Technology and Policy Conference 2016

Santa Fe, New Mexico, USA
25 - 30 September 2016

ISBN: 978-15108-4292-2

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571

Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2016) by American Nuclear Society
All rights reserved.

Printed by Curran Associates, Inc. (2017)

For permission requests, please contact American Nuclear Society
at the address below.

American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60526
USA

Phone: (800) 323-3044
(708) 352-6611
Fax: (708) 352-0499

www.ans.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

An MCNP6 Assessment of the Source Reconstruction Capability using EPR, TL and OSL 1
R. Hayes
Using Kernel Density Estimation for Nonproliferation Applications 4
R. Hayes
Application of Automated Weight Window Generation Techniques to Modeling the Detection of Shielded Nuclear Material 8
J. Kulesza, B. Kiedrowski, E. Larsen
The Master of International Policy Program at the University of Georgia 11
S. Kutchesfahani
Banning the Production of Highly Enriched Uranium (HEU) 14
F. Hippel
TENDL-2015: Delivering Both Completeness and Robustness 17
J.-Ch. Sublet, A. Koning, D. Rochman, M. Fleming, M. Gilbert
Toward Transparency and Broader Safeguards Conclusion: An Analysis of the Proposed Nuclear Power Program of the Kingdom of Saudi Arabia (KSA) 21
T. Alhuzaymi, A. Alajo
Generating Reactor Simulations for Nuclear Nonproliferation LA-UR-16-21931 25
P. Jaffke
Integrating Multimedia Information in IAEA Safeguards 29
M. Barletta, M. Fowler, J. Khaled
High-throughput Micro-analytical Sample Generation and Analysis of Process Salts 33
C. Launiere, J. Savina, C. Pereira
Neptunium-236 Production for Nuclear Forensic Reference Materials 37
S. Goldberg, J. Morrison, R. Essex, D. Phillips, D. Mackney, K. Carney, S. Jerome, M. Fassbender, S. Lamont, M. Nortier
Enabling Comparative Neutron Measurements of Spent Fuel Assemblies for Nonproliferation Purposes 39
B. Adigun, S. Tobin, H. Trellue, M. Fensin, M. Fugate, G. Dean, J. Tutt, J. Sprinkle
A New Approach to Estimate Uncertainty in Waste Characterization 43
B. Zaffora, M. Magistris, G. Saporta
Proof of Principle Simulation of a Handheld Neutron Scatter Camera 47
M. Ruch, P. Marleau, S. Pozzi
Proliferation Resistance Evaluation of an Advanced Fuel Cycle Employing High Temperature Gas Cooled Reactors 51
T. Aoki, H. Sagara, S. Chirayath
Second-Order Adjoint Sensitivity Analysis Methodology (2^{nd}-ASAM) Applied to Quantification of Non-Gaussian Uncertainties in a Nonlinear Heat Conduction Benchmark 55
D. Cacuci
Validation and Uncertainty Quantification of Hyperspectral Image Modeling 59
D. Engel, T. Reichardt, T. Kulp, R. Sommers, K. Krafcik
On Developing a Nuclear Material Accountancy and Control Approach for Fukushima Daiichi Fuel Debris 63
C. Heinberg, K. Hori
Pattern Recognition in Studies that Inject Synthetic Signals into Real Background 67
T. Burr, S. Croft, K. Jarman
Opportunities for Improving the Effectiveness and Efficiency of International Atomic Energy Agency Safeguards at Large-Scale Gas Centrifuge Enrichment Plants 71
M. Walker, R. Goldston
Uncertainty Quantification in Human Reliability Modeling for Security Screening Operations 75
B. Stanfill, R. Brigantic, C. Perkins, E. Brayfindley
Imaging Spent Fuel Casks Using Cosmic-Ray Muons 79
D. Poulson, J. Durham, E. Guardincerri, C. Morris, J. Bacon, K. Plaud-Ramos, D. Morley, A. Hecht
The 2015 US-ROK Nuclear Cooperation Agreement: Creative Compromises? 81
W. Boettcher
Objective-Based International Safeguards 85
B. Moran

Towards Stand-Off Nuclear Reactor Monitoring Using Neutron Detection 89
B. Ende, L. Li, B. Sur
Real Progress Reducing Highly Enriched Uranium 92
G. Person, C. Irons, J. Stamos, B. Eddy
Characterization and Comparison of New-Generation Silicon Photomultipliers 96
M. Wonders, M. Flaska
Assessing Impact of Monoenergetic Photon Sources on Nonproliferation Applications 100
C. Miller, B. Ludewigt, B. Quiter, S. Pozzi, C. Geddes
Liquid Scintillator-Based Fast Neutron Coincidence Counter for Fresh Nuclear Fuel Measurements 104
T. Lee, A. Tomanin, J. Beaumont
High Resolution X-ray (hiRX): New Instrument for Nondestructive Pu Assay 108
K. McIntosh, G. Havrilla, R. Gilmore, M. Holland
Social Media Analytics for Event Detection and Enrichment 110
J. Bakerman, K. Pazdernik, A. Wilson
Acoustic Techniques for Density and Mass Flow in Enrichment Plants 114
K. Denslow, M. Good, M. Hughes, A. Jones, G. Longoni, T. Moran, P. Ramuhalli, S. Roy, E. Smith, G. Warren
Next Generation Pulsed Portable Neutron Generators for Nondestructive Assay 117
D. Williams, A. Chen, C. Gary
Nuclear Data for Calculation of Nuclear Reactors Antineutrino Spectrum 119
A. Sonzogni, E. McCutchan, T. Johnson
Qualification of Centrifugal Tensioned Metastable Fluid Detector (CTMFD) Sensors for γ-β Blind Functionality in Spent Nuclear Fuel Reprocessing Facilities 122
J. Webster, D. Perez-Nunez, R. Taleyarkhan
LLNL's Support to DOE/NNSA's Next Generation Safeguards Initiative in the Area of International Safeguards Education and Training 126
Y. Feldman, G. Anzelon
Correlation Effects in Uncertainty Calculations Involving Atom (or Weight) Percent Isotopic Abundances 129
K. Mathew, M. Thomas
Non-Proliferation for Advanced Reactors: Political and Social Aspects 133
G. Clark, R. Duffey
Determination of ^{241}Am in Weapons Grade Plutonium for Chronometry Applications 137
M. Yoho, D. Porterfield, J. Rim, D. Klundt
Combining Inspection and Unattended Monitoring: Statistical Analysis of Timely Detection 139
K. Jarman, L. Smith
Data Fusion for a Vision-Radiological System: Calibration Algorithm Response to Gamma-rays vs. Neutrons 143
K. Stadnikia, A. Martin, P. Riley, K. Henderson, S. Koppal, A. Enqvist
Full-energy Peak Efficiency Calibration of a HPGe Detector Using Radioactive Sphere Source 147
M. Abbas
The Proliferation Resistance of a Nuclear Fuel Cycle Based on Pyrochemical Processing of Pressurized Water Reactor Spent Fuel 150
J. Kang, T. Cochran, M. McKinzie
Reducing Proliferation Risk Scenarios Towards More Sustainable Nuclear Energy Systems 152
L. Durpel, C. Jorant
Characterization of a LiF/ZnS-based Neutron Multiplicity Counter 156
S. Stave, S. Behling, M. Bliss, C. Cowles, R. Kouzes, V. Kukharev, A. Lintereur, S. Robinson, E. Siciliano, P. Valdez
Simulation and Optimization of Systems of Nuclear Safeguards 160
N. Shugart, B. Johnson, J. King, A. Newman
What Is the Strategic Utility of Reactor-Grade Plutonium? 164
R. Reardon, J. Mattingly
Diversion Detection in Partially Observed Nuclear Fuel Cycle Networks 167
E. Hou, Y. Yilmaz, A. Hero
Focusing NMA&C Training on the Precise Group of Practitioners 171
J. Vidaurre-Henry, N. Miyagi, M. Hirai
Developing Intelligent Non-proliferation Enabling Capabilities: Very-Short-Term Prediction of Background Radiation in Radioactive Source Search Using Relevance Vector Regression 175
M. Alamaniotis, C. Choi, L. Tsoukalas
Alternate Nuclear Proliferation Pathways in the Age of Non-State Actors 179
J. Bevins, B. Goldblum, T. Hickey, E. Katzenson, J. Kendrick, R. Krentz-Wee, S. Laderman, Y. Tian, C. Ting, A. Wehsener

Spectroscopy of Femtosecond Laser-Produced Plasmas for Nuclear Forensics and Verification 184
K. Hartig, I. Jovanovic
High-fidelity Modeling of Spent Fuel Assemblies for Advanced NDA Instrument Testings 187
J. Hu, I. Gauld, V. Mozin, S. Tobin, S. Vaccaro, M. Bengtsson, A. Sjoland, A. Worrall
Warhead Verification with NRF 192
J. Vavrek, A. Danagoulian, R. Kemp, R. Macdonald
Y-12 Efforts to Reduce the Use of Highly Enriched Uranium 196
L. Jollay, H. Longmire, B. Wilhoit
Monte Carlo Simulations of a Physical Cryptographic Warhead Verification Protocol Using Nuclear Resonance Fluorescence 198
J. Vavrek, A. Danagoulian, E. Immerman, R. Kemp, R. Lanza, R. Macdonald, B. Osmanov
The Nonproliferation Portal 200
A. Rynes, Sean Morrell
Online Diversion Detection in Nuclear Fuel Cycles via Multimodal Observations 202
Y. Yilmaz, E. Hou, A. Hero
Use of Modeling and Simulation to Evaluate/Contrast Safeguards Regulatory Effectiveness 207
P. Gibbs, J. Calavuzzi
Savannah River Site's H Canyon Facility: Enriched Uranium Disposition Mission 211
V. Magoulas
Using Reproducibility to Test the Adequacy of GUM Based Uncertainty Quantification 215
S. Walsh, A. Venzin, D. Wegrzynek, C. Mansoux
Improved Transport Modeling to Support Post-detonation Nuclear Forensics 219
T. Cartledge, M. Pochet, K. Mueller, R. Roberts
Nonproliferation Education and Outreach 223
H. Hall, J. Auxier, J. Stainback, N. Peter-Stein, H. Ghoname, N. Rice
Determination of the Irradiation History of Americium/Beryllium Reactor Startup Sources Using Gamma Spectroscopy 225
A. Nettleton, A. Feldman
A Systems Thinking Approach to Open Source Analysis in Support of Nuclear Non-Proliferation 229
G. Renda, G. Cojazzi, L. Kim
Laser-Driven Neutron Source for Detection of Nuclear Material 234
A. Favalli, J. Bridgwater, S. Croft, K. Falk, J. Fernandez, D. Gautier, N. Guler, C. Hamilton, D. Henzlova, K. Ianakiev, M. Iliev, R. Johnson, D. Jung, M. Roth, T. Shimida, M. Swinhoe
$^{235}U(n_{th},f)$ Product Data Measurements with Correlated A, Z, KE with the UNM-SPIDER Spectrometer 237
A. Hecht, R. Blakeley, J. Cole, S. Fellows, P. Baldez
All-Particle Spontaneous-Decay and Delayed-Positron Capabilities in MCNP6 240
J. Tutt, G. McKinney, T. Wilcox
Subcritical Multiplication Experiments & Simulations: Overview and Recent Advances 244
J. Hutchinson, R. Bahran, C. Solomon, A. Sood, M. Smith-Nelson, W. Myers, T. Cutler, D. Dinwiddie, T. Grove
Generalized Quantification of Trace-level Fissile Material Mixtures Via Short-lived Delayed Gamma Spectroscopy 248
S. SKutnik, J. Knowles
Systematic Approach to Nuclear Data Uncertainty Quantification for Nuclear Security Applications 252
I. Gauld, S. Croft, M. Pigni, A. Nicholson, M. Williams, V. Mozin, C. Mattoon, R. Vogt, J. Caggiano, M. Swinhoe
The GIF Proliferation Resistance and Physical Protection (PR&PP) Evaluation Methodology: Status and Outlook 257
G. Cojazzi, G. Renda, R. Bari, J. Whitlock, P. Peterson, I. Therios, J. Cazalet
The Iran Procurement Channel – Is the Experiment Going to Work? 261
J. Kessler
Proliferation Resistance Redux 265
J. Pilat
Fixed Plant Analysis of Iran's Post-JCPOA Implementation Breakout Potential 270
B. Thomas, H. Wood
After Cooperative Threat Reduction: The Future of US-Russia Nuclear Security Engagement 274
E. Wilson
Analysis of RAPID Accuracy for a Spent Fuel Pool with Variable Burnups and Cooling Times 277
N. Roskoff, A. Haghighat, V. Mascolino
Nuclear Nonproliferation Modeling and Simulation Training at Virginia Tech 281
A. Haghighat

Void Reactivity Worth in Uranium/Lead Systems: A US-Japan Collaboration 285
J. Goda, J. Bounds, T. Cutler, T. Grove, J. Hutchinson, D. Hayes, M. James, G. McKenzie, E. George, R. Sanchez, M. Fukushima, H. Iwamoto, Akito Oizumo, K. Tsujimoto
Monte Carlo Uncertainty Quantification for an Unattended Enrichment Monitor 290
K. Jarman, L. Smith, R. Wittman, M. Zalavadia
Strengthening International Safeguards Implementation Through Engagement and Training 294
D. Kovacic, H. Hale
Preliminary Safeguards Assessment for the Pebble-Bed Fluoride High-Temperature Reactor (PB-FHR) Concept 298
J. Disser, E. Arthur, J. Lambert
Informational Sensing for Nonproliferation 302
J. Kornell, Z. Gastelum, B. Goldblum
Integration of the LLNL Fission Library/FREYA Package into MCNP6 307
J. Verbeke, M. Rising, R. Vogt
After The Final Nuclear Security Summit: Implementing Action Plan In Support Of The Unites Nations Non-Proliferation Mandate 311
S. Shirazyan
Neutronic Analysis of the CHANDLER Anti-Neutrino Detector 313
W. Walters, A. Haghighat
Quantifying Correlations Between International Relations and Nuclear Proliferation Status 317
N. Mahowald, B. Goldblum, T. Hickey, J. Kornell
Analysis on Plutonium Production In Fast Breeder Reactor (FBR) Cycle Based on Transuranium Fuel Loading 321
S. Permana, Z. Suud, Ismail, M. Suzuki, M. Saito
Uncertainty Quantification with the Event-by-Event Fission Model FREYA 323
R. Vogt, A. Nicholson, J. Randrup, I. Gauld, S. Croft
Developing a Verification Regime for Direct Disposal of Excess Plutonium 327
E. Lyman
Macri and the Changing Landscape of Argentine Non-Nuclear Proliferation Policy in a Post-Kirchner Era 331
A. Villanueva
Ten years of Nuclear Security Education, Research and Training at Texas A&M University 334
S. Chirayath, C. Marianno, C. Gariazzo, P. Nelson, D. Boyle, K. Ragusa
Defining a Research Agenda for Advanced Fuel Cycle Safeguards: A Focus on Thorium 338
L. Worrall, G. Flanagan, D. Holcomb, D. Kovacic, A. Worrall
Total Measurement Uncertainty Error Budget for a Tomographic Gamma Scanner 341
J. Kirkpatrick, S. Smith, D. Nakazawa, S. Croft, R. Venkataraman
Detecting Misuse of Aqueous Reprocessing Systems with the Multi-Isotope Process Monitor 344
J. Coble, N. Shoman, D. Meier
Material Detection in Hyperspectral Imagery in Support of Nuclear Nonproliferation 347
A. Ziemann, J. Theiler
Idaho National Laboratory Human Capital Development Program 351
A. Rynes
Feasibility of Using Social Media Analysis for International Safeguards Applications 353
A. Sayre, A. Kurzrok, E. Bell, E. Gallegos, C. Corley, J. Schweighardt
Correlated Fission Multiplicity Model Verification Efforts in MCNP6 357
M. Rising
Visualization and Analysis System for Discovery of Strategic Trade Patterns and Anomalies 361
P. Heine, J. Carrera, M. North
Source Localization Using a Single Volume Scatter Camera Made of Pillars of Plastic Scintillator 364
K. Weinfurther, J. Mattingly, E. Brubaker, J. Steele
Advances in Mass Spectrometry for Environmental Nuclear Safeguards 368
A. Pollington, R. Steiner, S. LaMont, W. Kinman
Training for Environmental Safeguards Sample Analysis 370
R. Steiner, S. LaMont, W. Kinman, A. Pollington, L. Hudston, D. Dry
Representing the Uncertainty Structure of the Factorial Moments of ^{252}Cf and $^{238;240;242}$Pu 371
S. Croft, A. Nicholson, D. Henzlova, A. Favalli
Nuclear Data Uncertainty Quantification – A Practical Example for Nuclear Measurements 375
M. Swinhoe, C. Mattoon, S. Croft, I. Gauld, A. Nicholson, V. Mozin
Material Control and Accountability in a Critical Experiment 379
R. Sanchez, T. Cutler, J. Bounds, T. Grove, J. Hutchinson, D. Hayes

Integral Experiments at the US National Criticality Experiments Research Center (NCERC) 382
D. Hayes, W. Myers, J. Goda, R. Sanchez, T. Grove, J. Hutchinson, T. Cutler, J. Bounds, G. McKenzie, D. Dinwiddie, R. Bahran, R. Little, A. Sood, M. White, R. Margevicius
Implementation of the Integral Nonproliferation Introductory Teaching and Learning (INITIAL) Module at US Universities 385
A. Trahan, R. Bahran
Update on the Nuclear Data Working Group 387
C. Romano
Monte Carlo and Deterministic Solutions of the Forward Master Equation for Random Neutron Populations 388
P. O'Rourke, A. Prinja, E. Fichtl
Detection of Radiation Signatures in Urban Environment 392
R. Stefanescu, K. Schmidt, J. Hite, R. Smith, J. Mattingly
Testing for the Poisson Distribution in Neutron Counting 396
A. Berlizov, T. Burr, S. Croft, A. Nicolson, A. Walczak-Typke
Revisiting Nuclear Fission Data for Nonproliferation Applications 400
P. Talou
International Nuclear Safeguards Human Capital Development at Sandia National Laboratories (SNL) 404
R. Haddal
Improving the Implementation of Safeguards and Security in Nuclear Facility Design and Construction 407
C. Scherer, E. Rauch, J. Sprinkle
Production of ^{236}Np and ^{236}Pu for Isotope Dilution Mass Spectrometry 410
M. Fassbender, L. Seaman, W. Runde, E. Birnbaum, J. Engle, S. Kozimor, F. Nortier, K. John, E. Balkin, D. Wilbur, G. Goff
The China Center of Excellence on Nuclear Security 411
J. Marlow
Energy-Resolved Neutron Imaging for Interrogation of Nuclear Materials 414
A. Losko, S. Vogel, M. Bourke, A. Tremsin, A. Favalli, S. Voit, K. McClellan
Predicted Radiation Output from Plutonium and Uranium Oxide 418
E. Shores, C. Solomon, J. Hutchinson, S. Myers, B. Temple, P. Felsher, M. Wyman
A New Model for Nuclear Proliferation 421
R. Peterson
AmBe Neutron Transmission Through a Beryllium Sphere 424
J. Stooksbury, N. Hertel
Multiplicity Expressions for Fissile Mass Estimation in a Fast Neutron Detection System 427
T. Shin, M. Hua, A. Fulvio, D. Chichester, S. Clarke, S. Pozzi
Cyber-Security Experimentation Platform for Instrumentation and Control Systems in a Nuclear Reactor 430
C. Reynolds, C. Bales, W. Nichols, C. Strong, J. Hale, M. Papa, P. Hawrylak
Author Index